

LISTING OF CLAIMS:

The present listing of claims replaces all prior listings or versions of claims in the present application.

1. (Currently Amended) A method for water hammerless opening of a fluid passage, comprising the steps of: ~~characterized by that, with the method by which the~~

~~(a) providing a fluid passage is made open- openable by operation means of an the~~
actuator operating type valve provided on the fluid passage of a pipe passage, wherein the
fluid passage has having the nearly constant pressure inside the pipe passage;

~~(b) moving a first the valve body of the actuator operating type valve is moved toward~~
~~a the direction of the valve opening by increasing or decreasing the afore-mentioned driving~~
input to an the actuator of the actuator operating type valve, wherein the driving input is being
increased or reduced to a the first prescribed set value; and

~~(c) holding the driving input to the actuator is held at the first afore-mentioned set~~
value for a first short period of time; and then, said

~~(d) further increasing or decreasing the driving input is further increased or reduced to~~
~~move make the valve body to in a state of full valve opening so, thus the fluid passage is being~~
opened without causing a water hammer.

2. (Currently Amended) A method for water hammerless opening of a fluid passage as claimed in Claim 1, wherein the valve is it is so made that a normally closed and pneumatic pressure operating type diaphragm valve; or a normally closed and pneumatic operating type diaphragm valve, wherein each of these diaphragm valves which is of a the fixed capacity type wherein an with the inner capacity of the valve is not being changed when the valve is operated, is employed for a valve.

3. (Currently Amended) A method for water hammerless opening of a fluid passage as claimed in Claim 1, wherein ~~it is so made that the~~ first period of time for the driving input to the actuator being held at the set value for a short period of time is made to be less than 1 second, and ~~at the~~ pressure rise value of the fluid passage is made to be within 10% of ~~at the~~ first pressure value before the valve is made to open.

4. (Currently Amended) A device for water hammerless opening of a fluid passage, ~~comprising; characterized by that it is so constituted that it comprised~~

(a) a valve comprising a valve body;

(b) an actuator disposed to drive the valve body;

(c) a vibration sensor removably fixed to ~~at the~~ pipe passage on ~~an~~ the upstream side of the valve;

(d) an electro-pneumatic conversion control device disposed to receive ~~at which the~~ valve opening/closing command signal input is inputted, wherein the electro-pneumatic conversion control device comprises a data storage part, wherein ~~an and with which the~~ actuator operating pressure P_a inputted to the actuator is controlled by ~~at the~~ control signal S_c stored in advance in the data storage part; ~~in advance,~~ and

(e) a computation control device comprising ~~equipped with a comparison computation circuit,~~ wherein the comparison computation circuit is disposed to receive as input ~~at which the~~ vibration detecting signal P_r from the afore-mentioned vibration sensor, ~~at the~~ step pressure setting signal P_s to be supplied to the actuator, ~~at the~~ step pressure holding time setting signal T_s , and ~~at the~~ permissible upper limit vibration pressure setting signal P_{rm} are inputted, and wherein the comparison computation circuit compares the ~~with which the afore-mentioned~~ vibration detecting signal P_r and the permissible upper limit vibration pressure setting signal

~~Prm are compared, and the afore-mentioned step pressure setting signal is adjusted by the comparison computation circuit so that, thus outputting the control signal Sc is outputted by the comparison computation circuit consisting of the afore-mentioned holding time setting signal Ts and adjusted step pressure setting signal Ps to the data storage part of the afore-mentioned electro-pneumatic conversion control device, wherein the control signal Sc comprises the holding time setting signal Ts and the adjusted step pressure setting signal Ps.~~

5. (Currently Amended) A device for water hammerless opening of a fluid passage as claimed in Claim 4, wherein ~~the it is so constituted that a computation control device~~ further comprises a step pressure setting circuit, a holding time setting circuit, a permissible upper limit vibration pressure setting circuit, a vibration pressure detecting circuit and ~~the a~~ comparison computation circuit; and when the vibration detecting signal Pr exceeds the permissible upper limit vibration pressure setting signal Prm immediately after ~~an the~~ actuator operating signal is step-changed, the step pressure setting signal Ps is adjusted toward ~~a the~~ rising direction, and when the vibration detecting signal Pr exceeds the permissible upper limit vibration pressure setting signal Prm immediately after the actuator operating pressure Pa is made to zero from the intermediate step operating pressure, the step pressure setting signal Ps is adjusted toward ~~a the~~ lowering direction.

6. (Currently Amended) A device for water hammerless opening of a fluid passage as claimed in Claim 4, wherein ~~the it is so constituted that an~~ electro-pneumatic conversion device comprises ~~the a~~ data storage part ~~that which~~ stores the control signal Sc from the computation control device, a signal conversion part, and an electro-pneumatic conversion part, ~~wherein an the~~ actuator operating pressure control signal Se is outputted from the signal conversion part to the electro-pneumatic conversion part based on ~~a the~~ control signal Sc'

stored in advance in the data storage part so that the pipe passage is opened without causing a
~~in advance with which no water hammer is caused.~~

7. (Currently Amended) A device for water hammerless opening of a fluid passage,
~~comprising: wherein it is so constituted that it comprises~~

(a) an actuator operating type valve installed on the fluid passage;

(b) an electro-pneumatic conversion device disposed to supply the 2-step actuator
operating pressure Pa to the actuator operating type valve;

(c) a vibration sensor removably fixed to the pipe passage on the upstream side of
the ~~above-mentioned~~ actuator operating type valve; and

(d) a tuning box disposed to receive as input the vibration detecting signal
Pr detected through the vibration sensor ~~is inputted and to output to the electro-pneumatic~~
~~conversion device from which the control signal Sc to control the step operating pressure~~
Ps' of the ~~above-mentioned~~ 2-step actuator operating pressure Pa ~~is outputted to the electro-~~
~~pneumatic conversion device, wherein the tuning box adjusts the control signal Sc so that the~~
output from the electro-pneumatic conversion device of the 2-step actuator operating pressure
Pa ~~comprising of the step operating pressure Ps', which makes the vibration detecting signal~~
Pr nearly zero, ~~from the electro-pneumatic conversion device by adjusting said control signal~~
Se.

8. (Currently Amended) A method for water hammerless opening of a fluid passage,
~~comprising the steps of: characterized by that, with the method for~~

(a) opening a fluid passage having for which a vibration sensor is removably fixed on
the upstream side of the actuator operating type valve installed on the fluid passage; and

(b) ~~inputting the vibration detecting signal Pr from the vibration sensor~~ is inputted to the tuning box; and then,

(c) ~~inputting the control signal Sc from the tuning box to an~~ is inputted to the electro-pneumatic conversion device; and, ~~thus the~~

(d) ~~generating a 2-step actuator operating pressure Pa generated in the electro-pneumatic conversion device when the by the afore-mentioned control signal Sc is inputted, and supplying the 2-step actuator operating pressure Pa to an being supplied to the actuator operably connected to the actuator operating type valve so that the actuator operating type valve is made to open in the 2-step operation, wherein the 2-step actuator operating pressure Pa to be supplied to the actuator and the vibration detecting signal are compared for the relative relationship of the two, and when if vibration is generated at the time when the first step actuator operating pressure Pa rises, the step operating pressure Ps' is lowered, and when if vibration is generated at the time when the second step actuator operating pressure Pa rises, the step operating pressure Ps' is raised, and the step operating pressure Ps' of the step operating pressure Pa, to make the said vibration detecting signal Pr nearly zero, is determined by repeating a plurality of adjustments of raising or lowering the afore-mentioned step operating pressure Ps' so that the afore-mentioned actuator operating type valve is made to open based on control signal Sc data on the control signal Sc when the 2-step operating pressure Pa of the step operating pressure Ps', to make generation of vibration nearly zero, is outputted from the electro-pneumatic conversion device.~~

9. (Currently Amended) A method for water hammerless opening of a fluid passage, ~~comprising the steps of: characterized by that, with the method for~~

(a) opening a fluid passage ~~having for which a vibration sensor is removably fixed on~~
the upstream side of the actuator operating type valve installed on the fluid passage; and

(b) ~~inputting a~~ the vibration detecting signal P_r ~~to a~~_{is inputted to the tuning box₁}; and
then,

(c) ~~inputting a~~ the control signal S_c from the tuning box ~~to a~~<sub>is inputted to the electro-
pneumatic conversion device; and, thus the</sub>

(d) ~~generating a~~ 2-step actuator operating pressure P_r ~~generated in the electro-
pneumatic conversion device by the~~ ~~when the~~ afore-mentioned control signal S_c ~~is inputted,~~
~~and supplying the 2-step actuator operating pressure P_a to a~~<sub>being supplied to the actuator
operably connected to the actuator operating type valve so that the actuator operating type
valve is made to open in a</sub> 2-step operation, ~~wherein the 2-step actuator operating pressure
 P_a to be supplied to the actuator and the vibration detecting signal P_r are compared for a~~
relative relationship of the two, and ~~when~~_{if} vibration is generated at ~~a~~_{the} time when ~~a~~_{the} first
step actuator operating pressure P_a drops, ~~a~~_{the} step operating pressure P_s' is raised, and
~~when~~_{if} vibration is generated at ~~a~~_{the} time when ~~a~~_{the} second step actuator operating pressure
 P_a drops, the step operating pressure P_s' is lowered, and the step operating pressure P_s' of the
2-step operating pressure P_a , to make ~~the~~_{said} vibration detecting signal P_r nearly zero, is
determined by repeating a plurality of adjustments of raising or lowering the afore-mentioned
step operating pressure P_s' so that the afore-mentioned actuator operating type valve is made
to open based on control signal S_C ~~data on the control signal S_c~~ when the 2-step operating
pressure P_a of the step operating pressure P_s' , to make generation of ~~said~~ vibration nearly
zero, is outputted from the electro-pneumatic conversion device.

10. (Currently Amended) A method for water hammerless opening of a fluid passage as
claimed in Claim 8, ~~or Claim 9~~ wherein it is so made that the vibration sensor and ~~the~~ tuning
box ~~are removeable, and are~~_{can be removed after the} control signal S_c ~~data on the control
signal S_c~~ at ~~a~~_{the} time of outputting the 2-step operating pressure P_a , with which generation of

vibration is nearly zero, are inputted to ~~at~~the memory storage of the electro-pneumatic conversion device.

11. (Currently Amended) A method for water hammerless opening of a fluid passage as claimed in Claim 8, ~~or Claim 9~~ wherein it is ~~so made that~~ the vibration sensor is provided at ~~at~~the position on the upstream side within 1000mm from the ~~place~~ where the actuator operating type valve is installed on the fluid passage.

12. (Currently Amended) A method for water hammerless opening of a fluid passage as claimed in Claim 8, ~~or Claim 9~~ wherein ~~it is so made that~~ the step operating pressure holding time t of the 2-step operating pressure Pa is set at less than 1 second.

13. (Currently Amended) A method for supplying a chemical solution, comprising the steps of: ~~wherein it is so made that with which~~

(a) supplying a fluid to ~~is supplied to~~ the fluid passage on ~~at~~the downstream side of an actuator operating type valve installed on the fluid passage by opening the fluid passage using ~~by means of the actuator operating type valve, wherein installed on the fluid passage has~~ having a nearly constant internal pressure therein, and the fluid is a chemical solution; wherein opening of the fluid passage includes the steps of ~~is used for a fluid, and~~

i. firstly, moving ~~at~~the valve body of the actuator operating type valve ~~is moved~~ toward ~~at~~the direction of valve opening by increasing or decreasing a ~~the afore-~~ mentioned driving input to an ~~the~~ actuator to the prescribed set value, wherein the actuator is operably connected to the actuator operating type valve; and

ii. secondly, holding ~~the actuator driving input is held at the afore-mentioned~~ set value for a first ~~short~~ period of time; and then, said

~~thirdly, further increasing or decreasing the driving input is further increased or decreased to move the valve body of the valve to make a valve in a state of full opening so that a water hammer does not occur at the time of the valve is being~~
opened.

14. (NEW) A method for supplying a chemical solution as claim in Claim 13, wherein the first period of time is less than 1 second.

15. (NEW) A method for water hammerless opening of a fluid passage as claimed in Claim 9, wherein the vibration sensor and the tuning box are removeable, and are removed after the control signal Sc data at a time of outputting the 2-step operating pressure Pa, with which generation of vibration is nearly zero, are inputted to a memory storage of the electro-pneumatic conversion device.

16. (NEW) A method for water hammerless opening of a fluid passage as claimed in Claim 9, wherein the vibration sensor is provided at a position on the upstream side within 1000mm from where the actuator operating type valve is installed on the fluid passage.

17. (NEW) A method for water hammerless opening of a fluid passage as claimed in Claim 9, wherein a step operating pressure holding time t of the 2-step operating pressure Pa is set at less than 1 second.